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nited States Department of Agriculture,

BUREAU OF ENTOMOLOGY,

L. O. HOWARD, Entomologist and Chief of Bureau.

THE APPLE-TREE TENT CATERPILLAR.

(*Malacosoma americana* Fab.)

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The conspicuous, unsightly nests or tents of this insect (fig. 2) are familiar objects in the spring in trees along roadways, streams, fences, in neglected orchards, and elsewhere. The gregarious caterpillars construct the tents for their protection, and these, at first small, are gradually enlarged as the larvæ grow, often to a foot or more in height and diameter, the size varying with the number

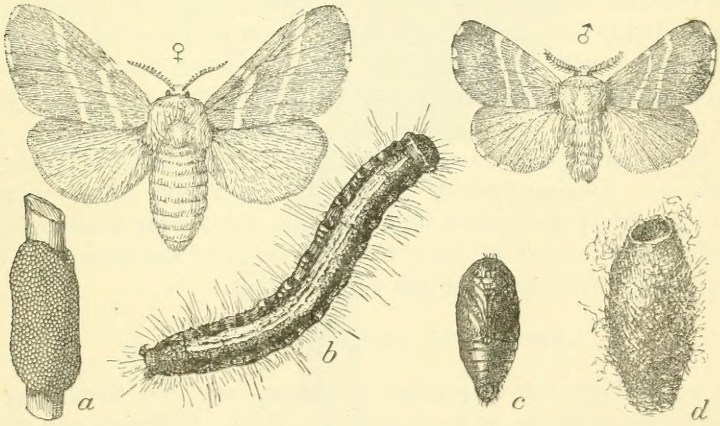

FIG. 1.—Stages of the apple-tree tent caterpillar: *a*, Egg mass; *b*, larva; *c*, pupa; *d*, cocoon; ♀, female moth; ♂, male moth. About natural size (original).

of individuals in the colony. The caterpillars feed upon the foliage of the trees, stripping the leaves from the limbs adjacent to the nest, and if there be several colonies in a tree, as is frequently the case during periods of abundance, the foliage may be quite destroyed, leaving the branches as bare as in midwinter.

DISTRIBUTION AND FOOD PLANTS.

The tent caterpillar is a native American species occurring quite generally in the United States from Canada south to Florida and westward about to the Rocky Mountains. From the Rockies to the Sierras, according to Dyar, the species is replaced by *Malacosoma fragilis* Stretch, which ranges from Canada to Mexico, and this latter form in the Pacific Northwest is replaced by *Malacosoma pluvialis* Dyar.

The tent caterpillar has been a troublesome pest from the earliest times. As stated by Fitch, its injuries in Massachusetts in the years 1646 and 1649 led the early settlers to term these "caterpillar years." At rather long and irregular intervals the caterpillars have been excessively abundant in different parts of their range, but more particularly in the New England States. This species was among the first to receive attention by the early American entomologists, and the principal features in its life and habits have been known for many years. Throughout its extended distribution the insect is likely to be abundant each year in one or more localities and often over a considerable territory. Scattered nests are to be found usually during any spring, though during some seasons these are but little in evidence.

The favorite food of the tent caterpillar is the wild cherry, and this is probably its native food plant. Next to the wild cherry the apple is apparently preferred. In the absence of its favorite food, or under special conditions, it attacks many other plants, as plum, peach, thorn, pear, rose, and other members of this group; also beech, witch-hazel, elm, maple, various species of willows, oaks, and poplars, etc. During periods of unusual abundance trees are more or less completely defoliated, and at a time when they most need the leaves for their growth or for the development of the fruit, and they are materially weakened, though rarely killed.

DESCRIPTION AND LIFE HISTORY.

The egg.—Eggs are deposited in masses or belts encircling the smaller twigs, as shown in fig. 2, and at *a*, fig. 1. Different egg masses may vary from one-half to three-fourths of an inch in length and contain from 150 to 250 eggs. The average number of eggs in several egg masses counted by Prof. V. H. Lowe on peach and apple was about 223 each. Each egg belt is deposited by an individual female and ordinarily represents the entire number which she will deposit. Eggs are placed on end, cemented closely together, the whole oval-shaped mass being finally covered with a layer of light-brown frothy glue, which soon becomes tough, brittle, and glistening.

Eggs are deposited by the moths by early midsummer, or earlier in the South, the embryonic larvæ developing so that by fall they are practically full grown, although remaining within the egg until the

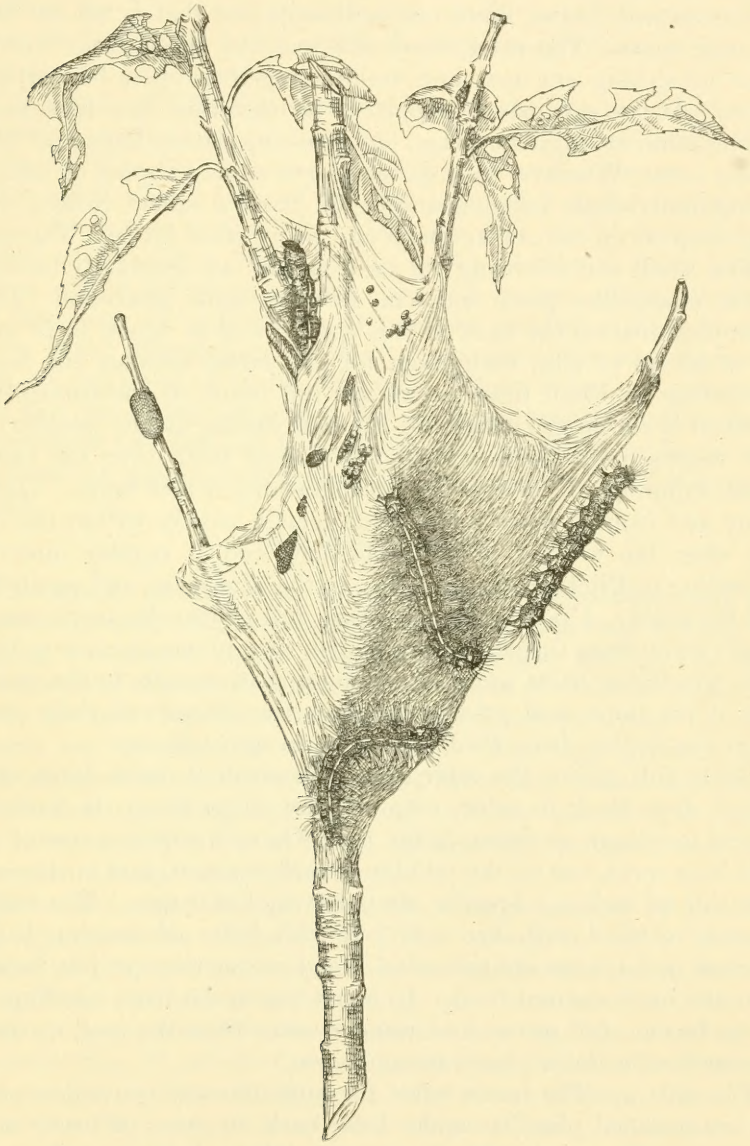

FIG. 2.—Apple-tree tent caterpillars (*Malacosoma americana*) and "nest;" egg mass or belt on small twig at left. "Nest" considerably reduced; caterpillars one-half natural size. (Original.)

following spring. With the coming of a warm spell the larvæ escape by gnawing through their egg shells, often before there is

foliage out for food, and under these circumstances they may feed upon the glutinous covering of the egg mass.

The larva.—In the presence of food the larvæ begin the formation of their nest in about two days from hatching, usually selecting the crotch formed by two limbs and ordinarily one that is not far from the egg mass. The caterpillars are sociable, those from one egg mass inhabiting one nest and feeding together upon the adjacent leaves. If two egg masses happen to be deposited close together, as on the same or adjacent twigs, the resulting caterpillars may unite in one nest. Wherever they go each larva spins a thread of silk, the young individuals hanging suspended from a silken thread when they drop, as do the cankerworms and many other larvæ. The nests, at first small and affording but little shelter, are gradually enlarged as the caterpillars grow and soon furnish ample protection. Upon close examination the nests of this species will be found to be made up of layers of silk, with room for the larvæ between the layers. According to Fitch these layers are the result of the caterpillars' habit of lying on the outside of the nest during bright weather, the few restless individuals crawling back and forth over the resting mass, spinning silk as they go, soon forming a new layer. During rainy and cloudy weather the larvæ remain mostly within the nest, but when the weather is favorable they feed at regular intervals; according to Fitch, in the morning, in the afternoon, and again during the night. Upon becoming nearly full grown the larvæ wander singly away from the nest, feeding upon such plants as come to hand. This wandering habit preparatory to pupation results in the scattering of the pupæ and greatly increases the chances of their escape from destruction from their numerous natural enemies.

When full grown the caterpillars are about 2 inches long, cylindrical, deep black in color, with a white stripe along the back and lateral markings, as shown in fig. 1, *b*. On each side is a row of oval pale-blue spots, one on the middle of each segment, and on the anterior side of each is a broader, deep velvety-black spot. The body is sparsely clothed with fine soft yellowish hairs of varying length, thickest perhaps toward the anterior end, where they project forward over the black-colored head. In about six weeks from hatching the larvæ become full grown and wander away from the nest, as stated, in search of suitable places for pupation.

The cocoon.—The larvæ select for pupation any convenient, more or less secluded place, as under loose bark, in grass or brush under trees, along fences, etc. If close to outbuildings the larvæ often make their cocoons in the angles along the sides, in window casings, etc. The cocoon, shown at *d*, fig. 1, is oval in shape, about 1 inch long, and composed exteriorly of coarse, loose, whitish threads of silk

surrounding the tougher parchment-like lining. The silk of the cocoon is intermixed with a yellow powdery substance which readily comes off when disturbed. Cocoons are made more or less singly, though in suitable shelter near the nest several may be found spun together, the larvæ taking advantage of the same protection. Cocoons are frequently found within the nest, though these will usually prove to be parasitized.

The pupa.—Within the cocoon the larva changes to a short, oval, brownish pupa, as shown at *c*, fig. 1. This stage lasts about three weeks, the time varying somewhat; then the moth appears.

The adult.—Both sexes of the tent caterpillar moth are shown in fig. 1, the female to the left. These are dull reddish-brown, stout-bodied moths, with a wing expanse in the females of about 1.5 to 2 inches, and in the males of from 1.2 to 1.3 inches. Obliquely across the forewings of each sex are two nearly parallel whitish lines, as shown in the illustration. Soon after emergence the sexes mate, and eggs are deposited on limbs and twigs. There is but one generation each year, the insects existing in the egg stage throughout the remaining summer and fall and through the winter, the young larvæ coming from the eggs in early spring and forming their nests, or tents, as stated.

NATURAL ENEMIES.

This species is subject to attack by numerous parasitic and predaceous enemies, which undoubtedly exert an important influence in keeping it reduced. Very minute, four-winged flies of the order Hymenoptera deposit their eggs within those of the tent caterpillar moth, the resulting larvæ or grubs finding sufficient food for their growth and development to parent flies. Four egg parasites have been recorded for this species, namely, *Telenomus clisiocampæ* Riley, *Pteromalus* sp., *Platygaster* sp., and *Ablerus clisiocampæ* Ashm., the latter record, however, being undoubtedly incorrect, since this species is parasitic upon scale insects.

Larvæ and pupæ furnish food for a large number of parasites and hyperparasites. Thus W. F. Fiske[a] records a total of some 24 species of insects which directly or indirectly feed upon the tent caterpillar. Primary parasites which have been recorded from the larva and pupa are: *Pimpla conquisitor* Say (see figs. 3 and 4), *P. inquisitor* Say, *P. pedalis* Cress., *P. annulipes* Brullé, *Apanteles congregatus* var. *rufocoxalis* Riley, *A. clisiocampæ* Ashm., *Limnerium fugitivum* Say, *Ameloctonus clisiocampæ* Weed, *Anomalon exile* Prov., *A. anale* Say, *Spilocryptus extrematus* Cress., *Rhogas intermedius* Cress., *Bracon gelechiæ* Ashm., *Diglochis omnivorus* Walk.,

[a] Tech. Bul. No. 6, N. H. College Agric. Exp. Sta., p. 2 (1903).

Theronia melanocephala Brullé (?), and the dipteron *Frontina frenchii* Will.

Among predaceous insects are several species of ground beetles which are said to feed upon the larvæ, among them *Calosoma scrutator* Fab. Among the Hemiptera Mr. A. H. Kirkland has observed several species of Podisus attacking the larvæ (*Podisus placidus* Uhl., *P. modestus* Dall., and *P. serieventris* Uhl.) and the rudiviid *Diplodus luridus* Stål. Also, according to Professor Bruner, *Podisus spinosus* Dall. and *Perillus claudus* Say are enemies of the caterpillars.

While most birds, as a rule, do not feed on hairy larvæ, such as the tent caterpillar, yet several species are known to include this insect in their diet, as the black-billed and yellow-billed cuckoos, the bluejay, and, according to Mr. E. H. Forbush, the crow, chickadee,

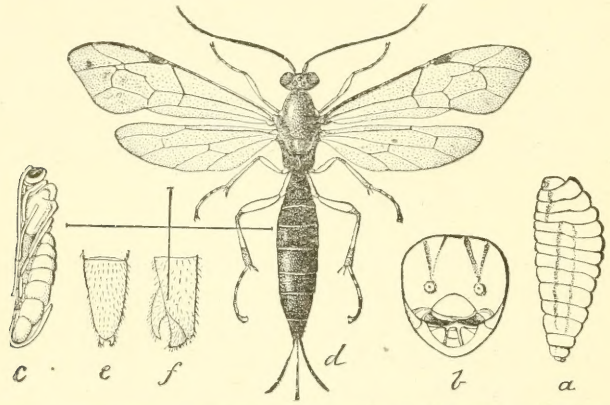

FIG. 3.—*Pimpla conquisitor*, an important parasite of the tent caterpillar: *a*, Larva, enlarged; *b*, head of same, still more enlarged; *c*, pupa; *d*, adult female, enlarged; *e*, *f*, end of abdomen of adult male, still more enlarged. (From Fourth Rept. U. S. Entom. Comm.)

Baltimore oriole, red-eyed vireo, chipping sparrow, and yellow warbler. Kirkland states that the common toad feeds greedily on tent caterpillars, he having found in their stomachs the remains of from 15 to 20, and in one instance 37 of these larvæ.

The caterpillars are also subject to destruction by a bacterial disease, especially when they become grown or nearly so, and sick, sluggish individuals may often be observed lying outside at full length on the nest. Larvæ killed by this disease are soft-bodied, the skin easily rupturing and permitting the escape of the liquid decomposed body contents.

METHODS OF CONTROL.

Removal of useless trees.—As has been stated, the unsightly nests of the tent caterpillars are especially apt to be found on wild cherry, apple, and other trees growing along roadsides, fences, and elsewhere.

In most cases such trees could doubtless be removed without disadvantage, and their removal would greatly reduce the numbers of this pest by lessening their favorite food supply.

Collecting the eggs.—During the dormant period of trees, when the leaves are off, the egg masses are fairly conspicuous, and with a little practice may be readily found; it is then that they should be cut off and burned. Trees infested with larvæ during the early part of the year, or those in the immediate vicinity, are perhaps more likely to be chosen by the parent moth for the deposition of her eggs, and such trees at least should be searched if it is not practicable to extend the work to the orchard as a whole. This work may be combined with pruning to good advantage, and a lookout should be kept not only for the eggs of this insect but for the eggs and cocoons of other injurious species which pass the winter on the trees.

FIG. 4.—*Pimpla* in the act of ovipositing on cocoon of tent caterpillar. Somewhat enlarged (after Fiske).

DESTROYING THE CATERPILLARS.

Neglect to search out the egg masses during the winter will result in the appearance of the larvæ about the time the trees are putting forth foliage. The nests, at first small, are soon so increased in size as to attract attention. If the caterpillars are destroyed as soon as the small nests are detected, this will prevent further defoliation of the trees, and the rule should be adopted to destroy them promptly as soon as discovered. In this work either of two practices may be resorted to, namely, destruction by hand or with a torch.

When in convenient reach the nests may be torn out with a brush, with gloved hand, or otherwise, and the larvæ crushed on the ground, care being taken to destroy any caterpillars which may have remained on the tree.

The use of a torch to burn out the nests will often be found convenient, especially when these occur in the higher parts of trees. An asbestos torch, such as advertised by seedsmen, will be satisfactory, or one may be made simply by tying rags to the end of a pole. The asbestos or rags are saturated with kerosene and lighted and the caterpillars as far as possible cremated. Some caterpillars, however, are likely to escape, falling from the nest upon the application of the torch. In using the torch great care is necessary that no important

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injury be done the tree; it should not be used in burning out nests except in the smaller branches and twigs, the killing of which would be of no special importance. Nests in the larger limbs should be destroyed by hand, as the use of the torch may kill the bark, resulting in permanent injury.

Spraying with arsenicals.—Tent caterpillars are readily destroyed by arsenicals sprayed on foliage of trees infested by them. Dr. H. T. Fernald's careful experiments and those of Professor Lowe in determining the amount of poison necessary to kill the caterpillars show that the latter are very sensitive and are killed in from two to three days by the use of Paris green at the rate of 1 pound to 300 or 400 gallons of water.

Orchards or trees sprayed with arsenicals in the spring for the codling moth, cankerworms, or similar insects will be kept practically free from tent caterpillars, and this species rarely requires attention at the hands of the up-to-date commercial fruit grower. It will be troublesome in the scattered trees around the home or in the small orchard which is not regularly sprayed. On such trees the nests will likely be in evidence every spring, and during occasional years the caterpillars may be excessively abundant, completely defoliating the trees.

Even in the small home orchard of a dozen or more trees it will be found highly profitable to adopt a system of spraying which will control not only tent caterpillars but such serious pests as the codling moth, cankerworms, various bud and leaf feeding insects, and will greatly reduce injury from the curculio.

Any of the arsenical insecticides may be used, as Paris green, Scheele's green, arsenate of lead, etc. The former two are used at the rate of 1 pound to 150 or 200 gallons of water, and the latter at the rate of 2 pounds to 50 gallons of water, the milk of lime from an equal amount by weight of stone lime, as poison used, being added to neutralize any caustic effect of the arsenical on the foliage. Preferably, however, the poisons should be used in Bordeaux mixture, thus effecting a combination treatment for insects and fungous diseases. On stone fruits, such as cherry, peach, and plum, arsenicals are likely to cause injury to foliage and must be used with caution if at all. On such trees the arsenate of lead is preferable, as it is less injurious to foliage, and on all trees sticks much better. In spraying for the tent caterpillar only, applications should be made while the caterpillars are yet small, as these succumb more quickly to poisons than when more nearly full grown, and prompt treatment stops further defoliation of the trees.

Approved:

JAMES WILSON,
Secretary of Agriculture.

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